

What is claimed is:

- 1 1. A method for forming a floating gate, comprising:
2 providing a semiconductor substrate, wherein a gate
3 dielectric layer and a conducting layer are
4 sequentially formed on the semiconductor
5 substrate;
6 forming a patterned hard mask layer having an opening
7 on the semiconductor substrate, wherein a portion
8 of the surface of the conducting layer is exposed
9 through the opening;
10 forming a spacer on a sidewall of the opening;
11 removing the patterned hard mask layer;
12 forming a conducting spacer on a sidewall of the spacer;
13 and
14 sequentially removing the exposing conducting layer and
15 the exposing gate dielectric layer.
- 1 2. The method for forming a floating gate of claim 1,
2 wherein the hard mask layer is a silicon nitride layer.
- 1 3. The method for forming a floating gate of claim 1,
2 wherein the gate dielectric layer is gate oxide layer.
- 1 4. The method for forming a floating gate of claim 1,
2 wherein the conducting layer is a poly-layer.
- 1 5. The method for forming a floating gate of claim 1,
2 wherein the spacer is an insulating layer.
- 1 6. The method for forming a floating gate of claim 5,
2 wherein the insulating layer is silicon oxide layer.

1 7. The method for forming a floating gate of claim 1,
2 wherein the material of the insulating layer is different from
3 the hard mask layer.

1 8. The method for forming a floating gate of claim 1,
2 wherein the conducting spacer is a poly-layer.

1 9. A method for forming a floating gate, comprising:
2 providing a semiconductor substrate;
3 sequentially forming a gate dielectric layer and a first
4 conducting layer on the semiconductor substrate;
5 sequentially forming a hard mask layer and a patterned
6 resist layer having a first opening on the first
7 conducting layer, wherein a portion of the hard
8 mask layer is exposed through the opening;
9 etching the hard mask layer to form a second opening using
10 the patterned resist layer as a mask;
11 removing the patterned resist layer;
12 conformally forming an insulating layer on the surface
13 of the hard mask layer, wherein the second opening
14 is filled with the insulating layer;
15 anisotropically etching the insulating layer to form a
16 first spacer on a sidewall of the second opening;
17 removing the hard mask layer;
18 conformally forming a second conducting layer on the
19 surface of the first conducting layer and the first
20 spacer;
21 anisotropically etching the second conducting layer to
22 form a second spacer on a sidewall of the first
23 spacer;

24 sequentially removing the exposing first conducting
25 layer and the exposing gate dielectric layer,
26 wherein a floating gate consists of a first
27 conducting layer and the second spacer.

1 10. The method for forming a floating gate of claim 9,
2 wherein the gate dielectric layer is a gate oxide layer.

1 11. The method for forming a floating gate of claim 9,
2 wherein the first conducting layer is a poly-layer.

1 12. The method for forming a floating gate of claim 9,
2 wherein the hard mask layer is a silicon nitride layer.

1 13. The method for forming a floating gate of claim 9,
2 wherein the insulating layer is a silicon oxide layer.

1 14. The method for forming a floating gate of claim 9,
2 wherein the material of the insulating layer is different from
3 the hard mask layer.

1 15. The method for forming a floating gate of claim 9,
2 wherein the second conducting layer is a poly-layer.

1 16. The method for forming a floating gate of claim 9,
2 wherein a method of the anisotropically etching is a plasma
3 dry-etching process.

1 17. A floating gate, comprising:
2 a conductive base; and
3 a pair of conductive protruding layers, wherein the
4 conductive protruding layers are formed on the
5 conductive base, each conductive protruding layer

6 has a bottom portion and a tip of the top portion
7 respectively, the bottom portion connects to the
8 conductive base, the conductive protruding layer
9 stretches out toward the other layer from the
10 bottom portion to the protruding tip of the top
11 portion thereof, and a floating gate with multiple
12 tips consists of the conductive base and the
13 conductive protruding layer.

1 18. The method for forming a floating gate of claim 17,
2 wherein the conductive base is a poly-layer.

1 19. The method for forming a floating gate of claim 17,
2 wherein the dual conductive protruding layer is a poly-layer.

1 20. A floating gate, comprising:
2 a conductive base; and
3 a conductive protruding layer, wherein the conductive
4 protruding layer is formed on the conductive base,
5 the conductive protruding layer has a first tip
6 portion and a second tip portion, the first tip
7 portion has a first bottom portion and a first tip
8 of the top portion, the second tip portion has a
9 second bottom portion and a second tip of the top
10 portion, the first bottom portion and the second
11 bottom portion connects to the conductive base, the
12 first tip of the top portion stretches out toward
13 the second tip of the top portion from the first
14 bottom portion, and the second tip of the top
15 portion stretches out toward the first tip of the
16 top portion from the second bottom portion, and a

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17 floating gate with multiple tips consists of the
18 conductive base and the conductive protruding
19 layer.

1 21. The method for forming a floating gate of claim 20,
2 wherein the conductive base is a poly-layer.

1 22. The method for forming a floating gate of claim 20,
2 wherein the conductive protruding layer is a poly-layer.